Preservation of a Computer-Based Art Installation

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Abstract. In contemporary digital art computer technology plays an integral part not only in the creation of art pieces but also in their functioning as art works. Such digital art works have usually a performative or interactive character and therefore rely on an underlying working computer system. Since computer and information technology advances with such unrelenting pace, hardware and software modules soon become obsolete. How to preserve such digital art works in these circumstances from a art conservation standpoint is much debated but not clear yet. In this article we present and discuss issues in the conservation of digital art works using a case study of a ten years old interactive art installation.

Keywords: digital art, conservation, case study, software maintenance.

1 Introduction

As with any new technology, artists soon accepted computers as a new tool for artistic expression. Since computer technology in its pioneer phase used as output devices mostly printers and plotters, computers were initially used in fine art primarily to produce prints. First art prints made with computers date to the 60-ties [2]. The use of computers was at that time more complicated than it is today, in the era of intuitive graphic user interfaces, so that artists had to employ the help of computer programers. This symbiotic relationship between artists and scientists or engineers remains alive in this lively area of using computers for arts's sake even today. Artists are usually not content to use some standard computer applications and solutions but are always trying to push the limits of existing technology [6]. And this requires the help of computer scientists [5,13].

Artistic interactive works range from very simple interactions where an observer or selected visitor is asked to press a button to initiate an action between the installation and itself. Then he simply observes the changes of the installation. Sometimes the interaction requires some motor skills, ability and practice, which means that the installation engages all of our senses [12]. Various sensors, cameras in particular, were used in the feedback loop that supported the interactivity. Multimedia and the invention of the World Wide Web gave the

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new tendencies in the arts a tremendous boost. Interactivity in the context of contemporary art and technology typifies a relation or cooperation between the machine and the subject [4]. Stephen Wilson [15,16] wrote two comprehensive surveys of new media art, where art, science and technology intermix.

Due to the fast development of computer technology, such computer based art works need to be adapted to new hardware and new software platforms, so that their use and appreciation can be pursued also in the future [7]. This necessary adaptation is a common issue in software engineering. In computer applications every new software version is expected to put to use the newest technical advances and to introduce new or better functionality. From an art conservation position, however, as much as possible of the original should be preserved. Therefore, in preservation of digital born art, these two principles clash. There are still no unique and clear guidelines for digital art conservation [7].

In this article we discuss the issues of digital art conservation on the example of the "15 seconds of fame" interactive art installation that generates pop-art like portraits and which was originally created in 2002 [9,11]. In the original version of this installation, a personal computer, a flat computer monitor and a separate digital camera was used. In the newest version of the same installation, a mobile phone is used, which offers enough computing power, a built-in camera, connectivity to a larger screen and connectivity to the Internet for distribution of portraits. The installation originally enabled access to the produced portraits through email. Now, in the era of social networks, users expect to share images through Facebook, Instagram, etc. Is such expansion of functionality in accordance with conservation principles? The installation performs automatic detection of human faces in images. In the past ten years, faster and more robust methods of face detection were developed. Is the use of newer and better methods acceptable from a conservation standpoint?

The rest of the article continues as follows: in Section 2 the functionality of the installation "15 seconds of fame" is briefly described, in Section 3 software maintenance from a software engineering perspective is presented, in Section 4 digital art conservation strategies are outlined, Section 5 compares the original and the latest version of the installation from a software and functional standpoint and, finally, Section 6 concludes the article with a discussion and some guidelines learned on the basis of this case study.

2 Interactive Art Installation "15 Seconds of Fame"

The installation 15 seconds of fame was inspired by Andy Warhol's often quoted statement that "in the future everybody will be famous for 15 minutes" [8] and his photography-derived paintings of famous people.

The installation tries to make users of the installation instantly famous by making their portraits in a Warhol-like, pop-art fashion, which would make them implicitly famous as they likeness would appear on walls of galleries and museums for the prophesied 15 minutes. However, fifteen minutes would hardly make the installation interactive, and therefore the "fame" interval, the time period in which each portrait is displayed, was shortened to 15 seconds. The faces for the portraits made by the installation are selected by chance among the detected faces of all people in front of the installation. This serendipitous selection of faces was used to allude to fame's tendency to be not only short-lived but also random. The installation was conceptualized already in 1996 and implemented in 2002 [9]. It was exhibited for the first time in 2002, at the 8th International Festival of Computer Arts in Maribor, Slovenia.

Fig. 1. Left, a group of people in front of the installation. Right, two pop-art portraits produced by the installation "15 seconds of fame".

The visible part of 15 seconds of fame consists of a computer monitor, framed like a painting. A digital camera is hidden in the frame, so that only a round opening for the lens is visible (Fig. 1). Pictures of gallery visitors standing in front of the installation are taken by the digital camera which is connected to a computer that processes the pictures and displays them on the monitor. Each digital photo taken by the installation every 15 seconds is analyzed by the computer to detect faces. Initially, we decided to use a color-based approach for face detection that we developed for this installation [10]. The color-based nature of this face detection makes it very sensitive to illumination. Since it was not always possible to exhibit the installation in daylight or white-balanced studio illumination, we tried to improve our face detection results by applying color-compensation methods [3].

The next step in generating a "15-second" portrait" is to randomly select one face among all detected faces and to crop it from the original resolution image. To achieve Warhol-like pop-art effects, a random combination of three well-known filters—posterize, color balance and hue-saturation—with an additional process of random coloring is applied. To drastically reduce the number of distinct colors similar-looking pixels are joined into uniform regions. In this way, millions of different filtering effects can be achieved. Two portraits generated by the installation can be seen in Fig. 1. The displayed portraits could be ordered by sending an email with the sequential identification number, displayed along the portrait, in the subject line to our server, where all generated portraits were stored for a limited time period. Further documentation about the project can be found here: `http://black.fri.uni-lj.si/15sec` and here: `https://www.youtube.com/watch?v=RCXoyDwaXc0`.

3 Software Maintenance

A substantial part of software that supports the functioning of modern society is so called legacy software that was originally developed for older computer systems but was later adapted to newer technology. Different types of maintenance exist: corrective to fix errors, perfective to implement new or revised requirements, adaptive to new technologies or platforms and preventive for internal reorganization. Software engineering issues special to interactive installation art were analyzed by Trifonova et al. [13].

From a digital art conservation point of view, adaptive maintenance is the most crucial, since it is almost unavoidable over a longer period of time if the goal is to keep the art works performing. Even if the goal of the maintenance is to keep the system performing as it is, new operating systems or other hardware or software modules can have a subtle influence on the appearance and behavior of the system and hence influence the aesthetics of the art work.

On another level of maintenance is the dilemma if existing methods and algorithms should be replaced with better, faster or more robust methods. This is a quite common question in fast moving technical areas such as computer vision. Errors or inconsistencies of existing methods might actually constitute an integral aesthetic feature of the original digital art work. Therefore before deciding on any maintenance work on a digital art piece, one should consider beside software engineering also conservation principles.

4 Digital Art Conservation

Digital art conservation is distinct from digital heritage, which strives for conservation of art in general by means of digitalization. Digital art conservation is about conservation of art that was already born in digital form. Although digital art was produced since very recently, from the 60-ties onward, and hence belongs to our times, it will soon be relegated to the past because of its ephemeral nature and highly transitive technology [7]. Digital art is a fast moving discipline, performative in its nature, subjected to ongoing development because creators adapt their creations continually to new technical developments. Conservation of digital art therefore sounds as an conservative endeavor as it would try to stop the fast moving development in digital arts. But as any artwork, digital art bears witness to the era and society in which they were created. Each piece of art could only be created in such a time, in such a society, not earlier and not later. Therefore, also the preservation of digital cultural artifacts assure a continuity of our memory within time.

Although a basic substance of any art work lies in the idea, such idea should be expressed, communicated, comprehended through being experienced by our senses. Documentation of an art work can therefore in no way replace the work itself. A painting cannot be replaced by a photography of the original. The same holds for digital art. Documentation of a digital piece of art can only help in remembering. One should strive to preserve also digitally encoded work in their historic form and their aesthetics, the behaviour of interactive installations, even under changing technological conditions.

This goal is very difficult to achieve since without constant maintenance of such works, the rapid technological advances makes them obsolete in a very short time period. Maintenance means ongoing replacement and renewal of their components, hardware and software elements, such as adapting to new operating systems, porting software to new hardware, transforming data to new formats, sometimes rewriting the entire code in a new programing language. This situation is very different from older art where conservation usually means preservation of the status quo.

Another serious problem in digital art conservation is the lack of expertise. Professionals in museums and galleries that are in charge of conservation have usually an entirely different set of skills, mostly related to classical art techniques.

Although meaningful solutions for digital art conservation can be proposed only for a limited time span and each art work should be approached on a case by case basis, two general strategies have evolved [7]:

1. To preserve the work's original behavior, as well as its aesthetics, the original components (computer, electronic interfaces, digital control units, monitors, sensors, etc.) or exactly identical equipment should be preserved as long as possible along with the original software in functioning condition. Namely, hardware such as display or projection equipment has an influence on the aesthetic dimension of a work, for example, a picture on a cathode ray terminal monitor looks different than on a modern, high-resolution raster screen. Faster, more robust and of a higher resolution therefore does not necessary mean an improvement in the context of digital art preservation. This strategy of preserving original components can be usually done only as long as the original equipment can be serviced.
2. As a parallel measure, the operating systems, programs, applications, sensors and any other components should be upgraded as necessary by the development in technology. This should be done, however, in such a way that the content, behavior and the aesthetics of the work do not change. However, artists who find themselves in this position, where in order to preserve their work, they have to migrate their system to new hardware, adapt to new operating systems, use better and faster sensors, etc., they often strive to improve at the same time not only the technical but sometimes also the aesthetic or functional aspect of their work. In such scenario, the work then becomes a permanent work in progress.

Although documentation can not replace the work itself, extensive documentation of digital art works is essential precisely because of the difficulty of proper conservation. Plans, texts, drawings, software code, photographs, screen captures, video documentation and interviews with authors should all be included in a comprehensive documentation.

5 Hardware and Software of the "15 Seconds of Fame" Installation

5.1 PC-Based Implementation

Hardware. In the original, PC-based version of the installation two hardware configurations were used, which was motivated also by the need of easier transportation of the installation to a new location.

1. In the very first version, the monitor was a 17" Samsung, the wooden frame for the monitor was on purpose very ornate and could not be disassembled. The camera was an Olympus C3020 ZOOM, with a 32–96 mm lens, set to wide angle. Image resolution was 2048×1536, which enabled detection of faces even of observers which were far away from the camera. The selection of the camera was motivated by the fact that Olympus offered the purchase of a SDK library for computer control of the camera, which was essential for our application, since we needed to trigger the camera from the computer and to transfer the captured images from the camera to the computer.
2. For the second version of the installation a wooden frame that could be disassembled for easier transportation was built. Since the cost/size ratio of flat computer monitors was decreasing substantially in that time period, a larger 19" Samsung monitor was selected. A smaller camera Olympus C40 ZOOM with lens 35–98 mm and resolution of 2272×1704 was used.

Software. The module for face detection was written in C++. Initially, a method of face detection based on skin color was used [10]. Before face detection the input image was reduced to 160×120 pixels. The smallest face that could be detected was 11×12 pixels and the largest 96×106. This detection method was very sensitive to changes in illumination although this problem was somewhat alleviated by using different methods of illumination compensation [3]. Later the new Viola-Jones method of face detection [14] which is not color dependent was used instead. A module for this method exists in the OpenCV library. The smallest face that could be detected was 24×24 pixels.

The module for color transformations which simulate the pop-art effects was also written in C++. The three color filters or transformations emulate filters for color balance, hue saturation and posterization from the open source program Gimp. Before the face image was subjected to color transformations, it was enlarged to the size 400×400 pixels.

The main communication module between the hardware and other software modules was written in Pascal/Delphi. The whole application was running under Windows XP and later modified and tested to run under Win 7. The entire system had about 4500 lines of code (Delphi, C++, C, C#).

5.2 Mobile Phone Implementation

Smart mobile phones are currently computationally as powerful as personal computers ten years ago. Considering the functionality required for our installation we need a smart mobile phone with a built-in camera, the possibility to connect to an external HD monitor, wireless connectivity to the Internet using WiFi or 3G-4G for distribution of images, and a powerful processor. The installation "15 seconds of fame" could therefore run on a smart mobile phone completely self contained.

The first migration of the "15 seconds of fame" to a mobile platform was done in 2010 in the format of an iPhone app, which is still available on the Apple iTunes store[1]. This app was meant primarily as a demonstration that such migration is possible and a teaser for the actual interactive installation. A user of the app could take a photo, decide to use face detection on the photo or not, and apply to the obtained image a randomly selected pop-art effect.

The second migration to an Android platform in 2014 has the goal to replace the personal computer and the attached digital camera in the actual installation. The phone can be connected to a large monitor so that the outside appearance of the installation can remain identical to the original version. At the same time, this mobile version could perform also autonomously only on the mobile phone. We use Android Studio and Java for application development. The size of the images is 500×500 pixels.

Beside recreating the identical appearance of the original installation using new hardware and software, a functional upgrade is also being developed in the sense of art work in progress. During the past exhibitions of the installation we observed that people are in general less and less wiling to watch still images even for only 15 seconds. We are considering to engage their attention by using slow motion video clips instead of still images and by turning the portrait into a 50×50 puzzle and displaying during the 15 seconds an animation of its assembly. For distribution of images we use a dedicated page on a social network.

6 Conclusions

The installation was from the beginning well documented (see Sect. 2). After gradual migrations to new versions of operating systems and a new method of face detection to keep the installation in a stable working order, a major upgrade was done by moving the installation to a mobile platform and rewriting of the entire code. The installation can remain after this overhaul exactly the same in appearance and in the way how visitors interact with it.

We were, however, at the same time tempted to try to "improve" the installation by conforming it to the recent trends in information society, such as connectivity to social networks which did not exist in its present form when the installation was created. Users of new media manifest a continuously diminishing attention time span and, therefore, by using video instead of still images, or by a gamification attempt, utilizing an animation of the gradual assemblage of the puzzle-portrait, their attention and observation of the portrait could be kept active for the entire 15 seconds.

[1] https://itunes.apple.com/us/app/15-secs-of-fame/id377858886?mt=8

Digital art conservation is confronting ever more challenging cases. While in the past, most digital art works were in a sense self-contained, off the grid, they are now more often dependent on some Internet services, such as in the case of the Atlas 2012 project [1]. Preserving such distributed digital art works which use cloud based services, over which one does not have any direct control, can be exceedingly difficult.

What have we learned in our case? The art installation could be maintained in a good working order by small changes every few years, reacting mainly to new versions of operating systems and using a better face detection method. After ten years a complete rewrite of code was necessary in order to port it to a different platform—an Android phone. This change to an intelligent phone platform was beneficial also from a space saving perspective since the entire necessary hardware is now hidden in the wooden frame.

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